

the animals were fed on moss. This suggests the mite may not be a parasite in the true sense and this is possibly an example of phoresy.

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DEPARTMENT OF ZOOLOGY,
N. WADIA COLLEGE,
POONA-1,
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P. V. JOSHI

19. BIONOMICS OF *AMPHIBOLUS VENATOR* (Klug) A REDUVID PREDATOR ON INSECT PESTS OF STORED PRODUCTS

INTRODUCTION

Amphibolus venator (Klug), a reduvid bug, is found in grain godowns and is a predator on almost all insect pests of grains and serves as a natural control over the pest population, feeding as it does on all stages of the insect pests. Its natural habitat appears to be dark corners, crevices and grain bags in godowns. Its number in the godowns increases along with the general increase in the population of insect pests.

Miller (1956) states, that this bug is universally distributed in warehouses through the agency of man, and is now cosmopolitan in distribution.

In order to study its relationship with the insect population of storehouses the present investigation was carried out and observations were made on the bionomics of the bug.

PRECOPULATION AND COPULATION

The freshly emerged adult female does not respond to the male for mating. On an average, four to five days are required after

emergence for the female to respond to the male for mating. Before copulation the male moves behind the female for sometime and later succeeds in mounting. The male clasps and grips the female with fore-legs, the female remaining quiet during the mating. Sometimes she moves around with the male on her back. The copulation takes about twenty to twenty-five (20 to 25) minutes.

OVIPOSITION AND FECUNDITY

The first oviposition takes place 1 to 5 days after copulation (average of 2.8 days). The period from the day of emergence of the adult to first oviposition is five to ten days, (average of 6.9 days). The eggs are laid in rows of 2 or 3. In the warehouse the female selects the spot for laying eggs in corners of jute bags preferably away from light. In the laboratory culture batches of eggs were glued to the surface of the container by their broader ends. The maximum number of eggs laid by a female was 237 and the minimum 80, the average being 128.8.

EGGS

Eggs when laid are creamy-white in colour and ovoid in shape. At the end of the incubation period of about 9 to 10 days the eggs assume reddish colour because of the developing embryo inside. At the same time the eggs shrivel towards the conclusion of the incubation. The first instar nymph emerges through the lid which is on the narrower end of the egg. First the head emerges followed by the rest of the body. The average measurements of 10 eggs are, length 1.82 mm., and breadth 0.806 mm.

DESCRIPTION OF THE VARIOUS INSTARS AND THEIR DURATION

The insect undergoes five instar stages before emerging as imago. All the nymphs hatching out on the same day did not grow at the same rate although the food, temperature and relative humidity were the same throughout. The duration of the nymphal period varied from 51 days to 134 days.

First Instar:

The freshly hatched nymphs are small and delicate measuring about 2.476 mm. in length and reddish in colour. Gradually the

body becomes dark brown except the abdomen which remains orange red. The dorso-lateral portion of the abdominal tergae has yellowish spots on either side. In the advanced stage the nymph measures about 3.08 mm., in length; with greatest width 1.108 mm. across the fifth abdominal segment. Body ovoid; head straight, twice as long as broad, measuring about 0.873 mm. in length. Compound eyes deep red, bulging out of the sides of the head. Maximum width of head is at the region of the eyes and measures about 0.458 mm. Antennae five-jointed reddish in colour and are about 1.67 mm. in length. The first segment is the shortest (0.12 mm., second 0.44 mm., third 0.31 mm., fourth 0.23 mm., fifth 0.57 mm.) and the last the longest.

A prominent white line from the frons of the head, along the thorax up to the first segment of the abdomen. This line is the ecdysial cleavage line through which the next instar emerges. The ecdysial line continues throughout the nymphal stage and becomes more prominent in the later stages. The rostrum is apparently three-segmented, measuring about 0.87 mm. in length and reaches up to prothorax; the distal segment bears very small sensory bristles. The head is connected to the thorax by a narrow constriction of the head. The thorax is distinct with three segments, prothorax, mesothorax and metathorax. The ecdysial mid-dorsal white line creates an impression of being three sclerites on either side. The wing rudiments are absent. The thoracic spiracles are situated ventro-laterally on meso and meta-thorax. Legs stout, with six joints, tarsi two-segmented. Prothoracic leg is directed forward and is of raptorial type. The femora of prothoracic and mesothoracic legs are incrassated bearing tubercle-like processes; perhaps useful in holding the prey in between femur and tibia.

Abdomen about 1.580 mm. in length ovoid, with ten visible segments. The 11th is ordinarily telescoped in the 10th and both segments are small, telescoped inside the 9th and are retractile. These evert if the abdomen is pressed. There are three dark spots on the abdominal tergae which are situated mid-dorsally. Eight pairs of abdominal spiracles. The first pair situated on the antero-lateral side of the first abdominal tergum and the rest situated ventro-laterally from 2nd to 8th sternum.

The duration of the life of the 1st instar nymph is 8 to 17 days (average 11.7 days).

Second Instar:

Second instar nymph is 3.985 mm. in length and 0.997 mm. across the thorax and 1.296 mm. across the abdomen. Head cylindrical,

straight and measures 1.093 mm. in length, width across eyes 0.534 mm. Antennae five-jointed, 2.001 mm. in length, Rostrum about 1.18 mm. in length. Prothoracic and mesothoracic sclerites are distinctly separate, the posterior surface of the notum convex. Prothorax is the widest segment of the thorax.

Legs are similar to those of the first instar nymph. The abdomen becomes swollen and ovoid and increases in length up to 2.043 mm. The ten segments of the abdomen are visible, the two last segments, 10th and 11th, are retractile as in the first instar. The sides of the abdomen are beset with yellow patches.

The duration of the life of the second instar nymph is 8 to 14 days (average 9.50 days).

Third Instar:

The third instar nymph measures about 5.165 mm. in length, colour same as of the second instar. Head 1.336 mm. in length and width across eyes 0.641 mm. Rostrum is 1.399 mm. in length. Thorax characterised by the marked development of pronotum which becomes convex laterally. Although the wing-pads are not distinct the postero-lateral sides of the mesonotum and metanotum exhibit lateral blunt outgrowths, which are equal in length. The maximum width of the thorax is 1.299 mm. There is no differentiation of mesonotum into scutum and mesoscutellum. The portion of the mesonotum is projected over the metanotum. The abdomen is elongated and is 2.6695 mm. in length. Maximum breadth across the abdomen 1.740 mm. All the abdominal segments are distinct. The last segment bears the anus.

The legs are similar to those of the second instar except for the increased size and length. The position of the abdominal spiracular openings is the same as in the first instar nymph. The duration of life of the third instar is 9 to 26 days (average 13.6 days).

Fourth Instar Nymph:

The fourth instar nymph resembles the preceding instar. It is about 6.302 mm. in length. The head capsule measures 1.336 mm. in length. The eyes project out from the antero-lateral aspects, and the width across the eyes is 0.734 mm. Antenna five-segmented and about 3.032 mm. in length. Thorax characterised by the marked development of the pronotum and mesonotum. Mesonotum widens and becomes convex. The development of the mesoscutellum is also observed and the midregion of the mesoscutellum produces a triangular projection posteriorly. The length of the mesonotum increases

considerably. The dark wing-pads of the mesonotum and metanotum increase and extend up to the second abdominal segment; are distinctly clear in this instar. The metanotum is comparatively poorly developed. The legs are similar to those of the third instar nymph but the serrations on the femurs of the first and second legs are blunt and not so prominent. The abdomen is elongate, ovoid and is 3.074 mm. long and the maximum width is 1.905 mm. The openings of the tracheae are as before. Duration of the life in fourth instar nymph is 10 to 28 days (average 16.0 days).

Fifth Instar:

The colour of the fifth instar nymph is dark brown initially but later it gradually lightens. It measures about 8.069 mm. in length. Head cylindrical and straight measuring about 1.962 mm. in length. Maximum width across the eyes is 0.868 mm. Antennae five-jointed and 3.668 mm. in length. Intercalary segments of the antennae are not yet developed. The rostrum becomes stouter and bent and is about 2.05 mm. in length. There are marked changes in the thorax in the fifth instar nymph. The thorax is about 2.20 mm. long, the width is 1.975 mm. The pronotum becomes broader and shows the same sculpturing as in the imaginal pronotum. Mesonotum develops immensely as compared to the metanotum. The mesonotum can be distinguished into scutum and scutellum, although the transverse suture is not developed. Wing-pads grow enormously, extending up to the third tergum and are black in colour. The mesothoracic wing-pads totally cover the metathoracic wing-pads. Abdomen is elongated and swollen. It measures about 4.23 mm. in length, with a maximum width of 2.517 mm. The first abdominal spiracle which is dorsal in position is prominent. The sides of the tergae exhibit yellow patches. Duration of life in the fifth instar nymph is 16 to 49 days (average 28.50 days).

Imago:

The freshly emerged imago is reddish in colour. The wings are transparent and colourless. After some time the colour of the body of the imago changes to black.

The male and female can be distinguished by the size and the length of the body. The male is smaller than the female and measures about 9.06 mm. in length, the width of the abdomen is 3.00 mm. The female measures 9.713 mm. in length. The abdomen is 3.253 mm. in width. The major changes from the fifth instar nymph to adult are mainly the appearance of the full wings, the formation of thoracic

tergal plates and the external genital plates. Ocelli appear on the head. The intercalary segments in the antennae are developed and pretarsus becomes three-segmented.

Longevity and Sex Ratio:

The length of life of the adult mated female is from 65 to 193 days, average being 116.5 days. The number of males and females in population is not equal. Average percentage of the two sexes was —males 44.55% and females 55.45%.

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INSTITUTE OF SCIENCE,
BOMBAY,
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V. V. SURLIKAR
V. B. TEMBE

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20. ON THE TIME OF EMERGENCE OF *CROCE FILIPENNIS* WESTW. (NEUROPTERA: NEMOPTERIDAE)

Croce filipennis Westw. is a beautiful insect of small size with an average forewing span of 2.5 cm. and an average body-length of one centimetre. It has clear, transparent and membranous forewings with the characteristic Neuropteroid venation. The hindwings are strikingly modified into long and narrow filamentous structures whose average length is 3.2 cm. The insect is active during twilight and is also attracted to light. Though a poor flier, the insect flies with graceful up and down movements with hindwings vibrating and trailing behind at an acute angle to the vertical. This beautiful insect is not